BIEB 156 – Population Genetics

Spring Quarter 2017
Syllabus

Basic Course Information

Course website: http://tritoned.ucsd.edu (BIEB 156 [Sp17]) – check in several times a week

Instructor: Sergey Kryazhimskiy

Email: skryazhi@ucsd.edu (this is the best way to contact me. Put BIEB 156 into the subject line.)

Office Location: Muir Biology Building, #3258

Office Hours: Monday, 10:00 AM to 11:00 AM

Instructional Assistants (IA's):

IA	E-mail	Office hours	Location
Alena Martsul	amartsul@ucsd.edu	By appointment	Muir Biology 3266
Jillian Schat	jillianschat@gmail.com	By appointment	Muir Biology 2145

Lectures and Discussion sections:

Lecture	Day	Time	Location
A00	Monday Wednesday Friday	9:00 AM to 9:50 AM	Mandeville Center B-210

Discussion sections are an important and required part of the course. You will be graded on your participation in the discussion sections. Sections will be devoted to problem solving and to discussing the lecture topics and papers related to lectures.

Section	Day	Time	Location	IA
A01	Tuesday	5:00 PM to 5:50 PM	Center Hall 205	Alena Martsul
A04	Tuesday	7:00 PM to 7:50 PM	Center Hall 205	Jillian Schat

Course Description

The goal of the course is to learn about the population-level processes that govern evolution. Mathematical foundations of population genetics are laid out and applications are discussed. Topics include: evolution of drug resistance, origin of species, evolution of engineered organisms.

Learning Outcomes

In this course, you will learn how and why genetic composition of populations changes over time, and what practical implications these changes can have. By the end of the course, you will be able to:

1. Explain the practical implications that currently on-going evolution has or can have in multiple biological systems, how it occurs, and how we study it.
2. Explain what genetic variation is, why it is important, how it can be measured, where it comes from and how it changes over time.
3. Explain how models are different from reality and why we need models.
4. Describe models used to understand the evolutionary processes going on in populations, and explain why certain models are used in certain situations.
5. List the forces that determine the dynamics of allele frequencies in a population and explain how these forces affect the dynamics. Draw a schematic of how an adaptive allele spreads in a population and explain which evolutionary forces are most important in which period of the spread and why.
6. List and explain the sources of stochasticity in evolution. Write down an expression for the probability of fixation an allele in a population, and analyze it.
7. Make basic population genetic calculations and estimates. For example, calculate the expected number of mutations that will arise in a population and “escape drift”, or estimate the number of generations to the most recent common ancestor of a group of individuals.
8. Give examples of the types of information one can extract from genetic data. Design a simple sampling and analysis procedure to obtain some of this information.
9. Construct a simple genealogical tree from genetic data and make basic inferences about population’s evolutionary past from it.

Course Prerequisites

BICD 100 (Genetics); MATH 11 + 11L or BIEB 100 or MATH 186

Population genetics is a quantitative discipline. To understand the material in this course, in addition to basic knowledge of genetics, you also need to have a working knowledge of calculus (including ordinary differential equations) and basic probability. We will review the key topics that will be necessary for this course, but a short review cannot substitute for solid knowledge of this material.

Required Learning Materials

Please have iClicker registered on TritonEd. Older versions of the iClicker can be used as long as the remote ID can be read and the remote can be registered on TritonEd. You cannot share an iClicker remote with another student enrolled in this class (but you can share with someone who is not in this class).

Short writing activities will be done in class and in discussion sections, so please bring paper, pens and/or pencils.

Optional Learning Materials

Richard Halliburton. "*Introduction to population genetics*", 1st edition. Pearson Education Inc (ISBN 0-13-016380-5).

All the required material will be covered in lectures. However, reading the textbook will likely be very helpful. The book will give you a sometimes different and/or wider perspective on some issues. It also has useful exercises similar to those that will be given on the exams.

Assessment

Item	Percent
Midterm exam	25%
Final exam	25%
Homework	25%
Group presentation*	10%
Participation in class†	5%
Quizzes in class‡	5%
Participation in discussion sections	5%

*See Group Presentation
†See Participation and Quizzes
‡As a rule, do not do calculations/quizzes on the same pieces of paper as your notes

Participation and Quizzes

For in-class questions we will mostly use Clickers, but there might also be short written exercises.

There will be two types of in-class questions, "Poll" and "Quiz" questions. Poll questions are intended to stimulate your thinking and for me to get feedback on how you understand the material. Answers to poll questions will not be scored. As long as you answer 80% of all (either poll or quiz) questions over the course of the quarter, you will get the full participation score. If you answer less than 80% of all questions, your participation score will be based on the proportion of all questions you answered. (2)

Quiz questions are intended to test your knowledge. The final score will depend on the fraction of quiz questions you answered correctly out of the total number of quiz questions asked during the quarter.

Group Presentation

An ability to work in a team is one of the most valuable skills that one can have in any future career.

Everyone will participate in a team project resulting in a presentation. The total score for the presentation for each student will consist of two parts, the Quality Score (QS) and the Contribution Score (CS). QS contributes 80% to the total score and the CS contributes 20%. All members of the same team will receive the same QS based on the assessment of the quality of the presentation by the instructor. CS will be determined by each individual's contribution to the team. Every team member will provide a confidential suggested score for every other team member, and the instructor will assign CS for each individual based on this input.

Course Policies

Homeworks

Homeworks will be due in class on Friday on the week specified in the Schedule below, unless instructed otherwise.

Late Turn-ins

Late turn-ins will not be accepted.

Grade Dissemination and Answer Keys

You can access your scores using the Grade Center in TritonEd.

I will try my best to return all graded quizzes and in-class writing materials. In general, do your calculations and in class quizzes on a separate piece of paper than your notes.

Graded homeworks will be returned to you at Discussion sections during the week following the due date.

Graded midterm exams will be returned to you either in Discussion sections or through the Exam Depot. An answer key will also be provided. Midterm problems that have revealed widespread confusion will be discussed in the Discussion sections. Also, see the Regrades policy.

Your final exam will not be returned and no answer key will be provided. If you need to see your final exam, you will be able to do so by setting up a special appointment with the instructor or the IAs.

Make-ups and Regrades

There will be no make-ups for in-class writing, quizzes, and presentations.

Make-ups for missed exams will be given only with a valid excuse. A valid excuse is a serious medical or family emergency. Appropriate documentation (for example, letter from doctor) is required. Extraordinary circumstances will be considered on a case by case basis. If you have such an emergency, inform the instructor as soon as possible. No midterm make-ups will be possible after the graded exams and answer keys have been returned.

Regrades can be requested only if there are errors in either the addition of points or the reading of your answers. If a regrade request is made, we may regrade the entire exam. If the score changes after the regrade, the new score will be recorded. **WARNING:** All exams will be photocopied before being returned to students. Do not modify your exam after it has been graded when asking for a regrade. Regrade exams found to be modified will be sent to the UCSD's Office of Academic Integrity.

Requests for regrading of exams must be made in writing (email is okay) within 2 days after the exam is returned and/or answer key is posted. Please explain concisely what errors you believe were made. All additional communications on regrade between the instructor and student will be conducted by email.

Teamwork Policy

You can work together with other students on homeworks and take-home exams, or you can consult with the IAs or the instructor, if you have questions. However, you must write the final solutions by yourself based on your own understanding, without consulting with other students. Thus, no two handed in homeworks/exams should ever be exactly identical.

Academic Conduct Policy

Academic conduct and integrity is an essential part of teaching and learning. Visit the Office of Academic Integrity (OAI) for more information.

Schedule

Week	Dates	Topics	Reading*	To do/Due
1	4/3 – 4/7	What is population genetics? Phenotypic and genetic variation. Review of genetics, calculus and probability. Reality vs. model.	Halliburton, Ch. 1, 2, App A	
2	4/10 – 4/14	Deterministic model of a haploid population. Fundamental theorem of natural selection Selection coefficient. Müller diagram.	Halliburton, Ch. 5.1, 5.9, 5.10	HW 1 due on 4/14
3	4/17 – 4/21	Deterministic model of a diploid population. Hardy-Weinberg equilibrium.	Halliburton, Ch. 3, 5	HW 2 due on 4/21

		Gene drive.		
4	4/24 – 4/28	New mutations. Mutation-selection balance. Population genetics of HIV.	Halliburton, Ch. 6	HW 3 due on 4/28
5	5/1 – 5/3	Genetic drift. Wright-Fisher model. Population size. Fixation probability.	Halliburton, Ch. 7	HW 4 due on 5/5
	5/5	Midterm exam in class		
6	5/8 – 5/13	Molecular evolution. Genetic variation between species.	Halliburton, Ch. 11.1, 11.2	HW 5 due on 5/12
7	5/15 – 5/19	Genetic variation within a species. Linkage and hitchhiking. Linkage disequilibrium. Examples of selective sweeps.	Halliburton, Ch. 10	HW 6 due on 5/19 Project teams finalized.
8	5/22 – 5/26	Coalescent. Most recent common ancestor.	Halliburton, Ch. 11.3	HW 7 due on 5/26
9	5/29	Memorial day – NO CLASS		
	5/30 – 6/2	Spatially structured populations. Mitochondrial Eve. Local adaptation.	Halliburton, Ch. 9	HW 8 due on 6/2
10	6/5 – 6/9	Cancer as an evolutionary process. Population genetics of speciation.		HW 9 due on 6/9 Team project presentations.
	TBD	Final exam (location TBD)		

*Always check the course website on TritonEd for an up-to-date reading list

Instructor Goals

At a minimum, I hope to pursue the following goals and solicit your open and timely feedback on how well we are meeting these goals:

- Communicate effectively and frequently;
- Be an enthusiastic, active and involved;
- Demonstrate a mastery of the discipline;
- Relate material to current practices;

- Clearly explain complex concepts and ideas;
- Provide a framework for lifelong learning;
- Strive to involve participant in class activities;
- Be available to assist participants in or out of class; and
- Have respect and concern for all participants.

To provide your feedback, you can either talk to the instructor in person during office hours, or relay your feedback through your IA (anonymously, if you wish).